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Most of the technologies used today come either directly or indirectly from mechanical engineering. Beginning with the industrial revolution, mechanical engineering has increased much of what humanity can do by creating machines that allow for more to be produced for less work. From old machines now in museums to new technologies to make everyday life easier, mechanical engineering is an exciting field with growing prospects.

The use of mechanical engineering spans throughout history and became a major field with the industrial revolution. The need for people to design machinery that could stand up to the rigors of production, created the need for engineers to develop the factory floors and any machines on them. Using the developments and creations from these factories, mechanical engineers also served a major role in designing the locomotives for trains, and the development of cars and their continued improvement.

One of the most important innovations for these technologies was the engine itself. The first steam engine was developed by Thomas Newcomen in 1710 and later improved upon by James Watt 50 years later. As discussed in the article "Harnessing the void: how the industrial revolution began in a vacuum--or, a pull is as good as a push" by Robert O. Woods, the engine works off of a difference in air pressure. Woods describes the pumping process used in steam engines as "[a]ctual work was performed by atmospheric pressure, forcing the piston into the partial vacuum left by condensing steam. Later measurements found that the cycle produced a mean effective pressure of 9 1/2 psi at best." Despite having a less than optimal pressure difference, the engine was still able to pump water up from increasingly deeper mine shafts.

The second innovation made by Newcomen was the ability for pistons to be fully automated. Pistons always need to reset after contracting so that there is a chamber to be compressed again. Newcomen first did this with several valves that had to be adjusted frequently so there was no loss in pressure (Woods). Today's engines achieve this by the use of the crankshaft and other pistons that trigger at separate times. This keeps the engine in motion and the pistons constantly alternating, resulting in engines being in idle.

In the 1760s, James Watt made innovations on the engine by adding the connecting rod and crankshaft so that the motion it generated could be transferred into a rotary force (Woods). This addition increased the uses of the engine substantially. While the original engine could be used to pump water to turn a water wheel, the addition of a crankshaft allowed it to take up a much smaller space. With later improvements in the efficiency of the engine, it was able to power trains and all other kinds of vehicles.

The problem with these early steam engines was that "[l]arger cylinders had to be hand ground and lapped... There would be horrendously inefficient ratios between the boiler and piston causing an extreme loss in efficiency" (Woods). This further reduced the use of these engines because they were very expensive to operate. At the time horses provided a comparable amount of work done. A secondary factor to the inefficiency of these engines was "Newcomen's belief that the volume of steam being produced was proportional to the volume of water in the boiler, rather than to the heat input" (Woods). By using such a large volume of water in the boiler, Newcomen increased the volume of water in the container so much so that for water to start boiling the temperature would have to be above 212 degrees Fahrenheit.

It was not until another man, named John Smeaton, started working on steam engines in the 1770's that the engines were able to run more profitably than horse power. He streamlined the ratios of the piston length, diameter, and pressure until they ran as efficiently as horse power. After the streamlining process of the engine was completed, a study was done to check this claim with the following results, "An engine … was seen to pump 250,560 gallons of water a day at a cost of 20 shillings. Two horses… were able to pump 67,200 gallons in the same time at a slightly higher cost" (Woods). This gave the engine an obvious advantage over the horses and soon led to the propagation of the engines throughout the industrial era.

Another major contributor to the field of Engineering was Nikola Tesla. He was the inventor of most of the things used in today's technology. The PBS special "Tesla, Master of Lightning" is a documentary on Tesla's life written by Robert Uth. The first of his major inventions discussed in the documentary was his induction motor which turns alternating current (AC) to mechanical power without any exposed wires like that of a direct current (DC) motor. He also revolutionized how power was transported with AC current. Before he came to America, New York and other cities were running on Thomas Edison's DC current, which could only travel short distances through cables thicker than a man's arm. Soon after Tesla, with the help of industrial tycoon George Westinghouse, a dam at Niagara Falls was made that delivered power all the way to New York.

More recent innovations in engineering have led to a resurgence in an old technology, the blimp. With new advances in the use of helium, a stable gas, instead of hydrogen, an extremely flammable gas, the technology is being used again. In the article "Blimps are Back, Elevated by New Roles, Materials ; Airships are Flying High in Military Capacities and Communications Possibilities, and Even Greater Heights are in the Works," Noah Shachtman talks about how blimps are starting to see a rise in use after the 70 year slump from failures in the past. As the materials needed for blimps get lighter and stronger, new blimp designs are able to fly much higher than before. One such use is replacing satellites. As said in the article, "It currently costs $25 million or so to put a satellite with a 1,000- pound payload into space. Sending a dirigible up a few miles into the air should cost a fraction of that" (Shachtman, 2). This fact makes the idea of using airships extremely enticing because it would be extremely cheap to provide these services.

Another type of blimp being funded by the U.S. military is discussed in "A Blimp or a Plane?" by Michael Abrams. The article discusses the newest blimp made by Northrop Grumman funded by the U.S. Military. The blimp is a revolutionary design that can stay in the air for twenty-one days without any servicing required, while every other aircraft can stay in the air for at most a day. It also can fly at a top speed of 92 miles per hour, compared to the Goodyear blimp which has a top speed of 53 miles per hour. The funding for this project comes from the military, because they are focused on its potential in war and disaster relief. This aircraft is great for aid because it can fly and land in areas that fixed wing aircrafts cannot and bring necessary aid to those in need.

The article "Military Airship: Return of the Blimp" also talks about this airship and how it can take off and land without the use of any ballast. Originally, ballast was necessary for airships to be able to take off, and as the fuel started burning off, it got significantly harder to land. With this new design, the blimp does not need any form of ballast for taking off or landing. Another amazing thing about it is its flexibility in carrying capacity. As said by Metzger, an engineer for the ship, "Some of the characteristics of our vehicle allow you to make trades between how long you'd like to stay in the air and how much cargo you'd like to carry. We have the ability to trade 23 days, to go 1,000 miles and carry 15, 20 or 30,000 pounds." The ship itself is an amazing feat of technology that should see a significant rise in use over the years.

Blimps are also being developed for unmanned operations, as discussed in the article "Robotic Airship Mission Path-following Control Based on ANN and Human Operator's Skill." Jinjun Rao and the rest of his team discuss how they created a robotic airship by having the software analyze the inputs of a human pilot and the responses made to adjust onto course. This article is interesting because it discusses the math behind creating the autonomous system, called the ANN. For the system to work it needs several inputs from a GPS, compass and gyros. The computing is done on ground because the system is still new and will need to be lightened so the airship can carry it. When that happens, and we do have more autonomous air vehicles, there can be a world of possibilities open for what they can do.

Another new technology being created by engineers for engineers is a tool able to create prototypes straight from a computer drafting program. The book *Rapid Tooling Guidelines for Sand Casting*, by Wanlong Wang, Henry Stoll, and James Conley, discusses fast fabrication, which is the process where an engineer sends the machine a Computer Assisted Design (CAD) file and it will print it out as a 3D model. One chapter in particular discusses the methods used to print out the object. As it is still a new technology it is extremely expensive to use, with prices for the machines at thousands of dollars, which only increases the larger the printer is. Another problem with most of these printers is a required support for the object because the material used is very malleable until it is cured. Probably the best design is the Sander's Prototype Method where it has "the droplets adhere to each other during the liquid-to-solid phase transition to form a uniform mass" (Wang, Stoll, Conley, 47). It also has a second dropper for a support material made mostly from wax that will melt away with low heat. This technology speeds up the time it takes to test a design substantially so engineers can spend their time more effectively.

A major issue in the engineering world is hydraulic fracturing, also known as fracking. As discussed in "Oil and Gas Rush" by Eva Kaplan-Leiserson, Fracking has immense environmental issues. It also has led to a massive increase in demand in the job market for engineers, so much so that companies are hiring engineers at a starting salary of one-hundred thousand dollars. The jobs related to fracking for engineers range from researching the environmental impact it has, trying to make the process more efficient, or maintaining facilities being used for fracking. Fracking itself has increased the "U.S. natural gas production [by] 25% over the last five years." With this dramatic improvement in the production of natural gas, the U.S. is moving to become self reliant with no need to import any natural gas. This massive increase in natural gas has also led to the lowering of industrial costs making it cheaper to produce items in the U.S.

Mechanical Engineering is an extremely broad field with many different applications for the degree. As stated by the U.S. Bureau of Labor Statistics (BLS), a mechanical engineer does things ranging from designing breaks to implementing factory equipment (United States). The average income of a Mechanical Engineer is $78,000 and it requires a Bachelor's degree.

Much of what is done in this job requires creativity and a firm understanding of math and physics (United States). An understanding of programming is also necessary because many of the calculations needed are long and can be done quickly with a simple program. An understanding of how to read and draft blueprints is also necessary; some of this can be done using drafting software.

For schooling, a student has several options one of which is going to a four year college straight out of high school. The second is to go to another four year college or a community college and later transfer to another school to finish the degree. The main difference between these two options is the cost. Going straight to a four year college is more expensive than transferring at a later date.

In general, an engineering student will usually find a paid internship after their junior year in college. Then they can choose to either graduate college in one year or go through a co-op program with the company they interned with and graduate in two year (BLS).

After schooling and any internships, there are many different jobs available for a mechanical engineer, one of which is working in a factory. Terry Pollman has spent a lot of his time in a factory as an engineer, starting with a General Mills in Gortens as a maintenance manager where he managed twelve mechanics. When the plant closed in 1988, he moved to the General Mills in West Chicago where he started working with cereal systems, and then moved to bulk unloading. He has been working at that General Mills plant for twenty-five years and is in charge of installing new equipment and disposing of the out dated equipment.

Much of what Mr. Pollman does involves expensive equipment and engineers working on that equipment. A natural question to ask is what happens when an engineer does his job incorrectly; his response was,

> If… a mechanical engineer [messes up], you get platforms that can't hold any weight, too much stress on a machine, or an inefficient machine. Generally, our equipment is assembled from parts from third party vendors, the engineer will take the parts and put them together in the most efficient design. If he fails to, either the parts don't fit together or the machine will fail easily.

When an engineer fails at his job, whatever firm he works for has to pay for it. The firm will make sure that everywhere he goes to find work will know what he did. Depending on how badly he failed, he may never find work as an engineer again. A byproduct of this is that most engineering internships are paid. Firms do this because they are putting a large amount of trust into an engineer, and they want to make sure that he will have an investment in his quality of work.

One last hurdle an engineer needs to pass is to get their Professional Engineer (PE) license for their state (United States). He can get this after getting a BS in Mechanical Engineering at a school accredited by the ABET, formerly called Accreditation Board for Engineering and Technology, and completing two tests. One is the Fundamentals of Engineering (FE) exam that is taken after graduation. Engineers who have passed this exam are called either Engineers In Training (EIT) or Engineer Interns (EI). An EIT will work for two years gaining experience as an intern and then take the Principles and Practice Engineering Exam. After passing the exam, he will finally get his PE license (ABET).

The new engineer may then choose to increase their professional involvement and join a profession association. One professional association in the field is the American Society of Mechanical Engineers (ASME). The publications from ASME are all about the codes for different engineering aspects such as boilers, escalators, cranes, etc. ASME has a free membership for College Freshmen and there is a paid membership with a discount for students. They have several conferences, such as a nano-engineering conference for medical biology, and they sponsor several competitions, like a human powered vehicle competition. Additional benefits for members include access to an online library maintained by ASME, the ability to mentor or to be mentored through ASME, invitations to local engineering events, and more.

Another is the National Society of Professional Engineers. The membership cost for Illinois is $135 for a licensed member and free for students. The national dues are $100 for a licensed member or a member and free for a student as well. To qualify for a student membership, a student needs to be enrolled in an ABET-approved engineering program or pre-engineering program with a transfer agreement to another ABET-approved engineering program. The benefits from NSPE are that it has 15 free professional development hours to maintain a PE certification. It also has a forum dedicated to finding jobs and posting resumes, a job outlook site independent of the BLS, and several free journals.

The job outlook for mechanical engineers is expected to grow nine percent from 2010 to 2020 according the BLS, which is slower than the average for other occupations (United States). If an engineer is having difficulty finding a job for salary, some companies will employ engineers temporarily, as a cost cutting measure instead of keeping them on staff. While on the job mechanical engineers can expect to be working on new hybrid vehicle designs trying to make the vehicles more efficient, or they will be working on factory equipment. Engineers working in factories will probably either be designing new robots for production or working on installing new systems into the factory.

Mechanical engineers generally work on the newest industrial pursuits, like in the field of alternate energies such as solar panels or wind turbines. Another pursuit is remanufacturing, where an engineer will take a piece of machinery already designed and try to reuse part or all of the machine to cut down on waste disposal costs. A final field is nanotechnology, where mechanical engineers would work in this field by creating the production aspect for creating the technology (United States).

The past of mechanical engineering was filled with technologies that spurred the industrial revolution and kept the revolution going. Now mechanical engineering is leading to even more interesting new technologies like blimps and 3D printing. With the field still expanding there are many career options available, from working in a factory, to designing the newest car. There are many options for mechanical engineers, they just need to find their calling.

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